spectrum lines by the action of a magnetic field on the source of light: Prof. Oliver Lodge, F.R.S.

Commensalism amongst marine animals: the Marine Biological Association.

Experiments on the transmutation of sound vibrations: Mr. J. Goold.

Examples of animal-forms peculiar to Lake Tanganyika: Mr. J. E. S. Moore.

The Tsetse fly and the parasite of Tsetse fly-disease, or Ngana: Dr. A. A. Kanthack, Mr. W. F. H. Blandford, and Mr. H. E. Durham.

(1) Egg of *Æpyornis maximus* (Grandidier), Madagascar; (2) egg of African ostrich for comparison of size; (3) photograph of a fossil frog (*Discoglossus Troscheli*, Meyer sp.) from the lignite (Miocene) of Rott, near Bonn, and sciagraph of a recent frog of the same genus (*Discoglossus pictus*, Otth), for comparison. By Messrs. James Green and James H. Gardiner: Dr. Woodward, F.R.S., on behalf of Mr. R. Damon.

Ceraterpeton Galvani, Huxley, coal measures, Kilkenny, Ireland: Dr. Woodward, F.R.S., for Mr. J. G. Robertson, of Dublin.

(1) Living specimens of the British Mymaridæ (egg parasites), terrestrial and aquatic; (2) mounted specimens of newly-discovered genera. Mounted specimens of newly-discovered male Prestwichia: Mr. F. Enock.

(1) Specimens of Lepidoptera altered by temperature experiments, and reared by the exhibitor; (2) some of the results of crossings carried out by the exhibitor: Dr. M. Standfuss, of Zürich.

Examples of alteration of insects by temperature applied in the pupal stage: Mr. F. Merrifield.

Some examples of geographical distribution among the micro-Lepidoptera, with specimens from different regions, and coloured maps: Lord Walsingham, F.R.S.

Blood corpuscles of some invertebrate animals. Digestive gland of *Ostrea*: Dr. C. A. MacMunn.

A rotating mirror, specially made to the order of exhibitor by the Cambridge Instrument Co.: Sir David Salomons, Bart.

A rowing indicator, giving continuous record: Mr. F. C. Atkinson.

A new pocket mercurial standard barometer: Prof. J. Norman Collie, F.R.S., and Captain H. H. P. Deasy.

An apparatus for investigating the influence of proximity of substances on voltaic action: Dr. Gore, F.R.S.

Micrometer for microscopic measurement of large objects. Manufactured by the Cambridge Scientific Instrument Co.: Prof. W. F. R. Weldon, F.R.S.

Earth thermometer. A simple apparatus for the determination of earth temperatures: Mr. E. H. Griffiths, F.R.S.

Experiments illustrating a new method of controlling the electric arc in its application to photo-micrography: Mr. T. A. B. Carver and Mr. J. E. Barnard.

Kamm's "Zerograph," or "Printing Telegraph System": Mr. L. Kamm.

New phototheodolite, designed by Mr. J. Bridges-Lee: Mr. Casella.

The following demonstrations, with experiments and lantern illustrations, took place in the meeting-room:—

Experimental demonstration of "some electric and mechanical analogues": Prof. W. E. Ayrton, F.R.S.

Lantern-slides from micro-photographs, illustrating nuclear division in animal and vegetable cells: Prof. J. B. Farmer. Slides were shown illustrating the process of fertilisation and segmentation of the egg in *Ascaris megalocephala*, and in *Fucus vesiculosus*.

INFLUENCE OF RÖNTGEN RAYS UPON ELECTRICAL CONDUCTIVITY.[1]

IN a note read on March 1 in the Royal Society of Edinburgh, Lord Kelvin, Drs. Beattie, and Smolan treat of the influence of the Röntgen rays on the conductivity of air, paraffin, and glass (NATURE, vol. lv. pp. 498-99). After careful experiments, made with different potentials, they conclude that no perceptible increase of the conductivity of paraffin and glass is produced on them by the action of the X-rays. On the contrary, Messrs. J. J. Thomson and M'Clelland have thought, after their experiments, that paraffin and glass, submitted to the X-rays, increase conductivity. I had employed myself in the same question some time before, and I have explained the results of my researches in two notes presented to the Royal Academy of Naples on May 9 and July 4, 1896, and in a third note presented to the Royal Academy of the Lincei in Rome on June 6, 1896. This last note begins with the following words:—

"My first idea was to study whether the X-rays, crossing a dielectric, could render it conductor, so as to facilitate across it the discharge of an electrified body. In these researches of mine I employed, as a dielectric, some paraffin because, besides its being one of the best insulators, it is also very transparent to the X-rays."

The results set forth in those three notes may be thus shortly re-stated.

The discharge of a conductor in the air, provoked by the X-rays, seems to take place by convection or transport; so to say by an electric dance of the particles in the air, roused by radiation. Righi's experiments lead likewise to a similar interpretation.

The discharge of the conductor becomes slower when the surface exposed to air is diminished—that is to say, when a portion of it is covered with paraffin.

A conductor, loaded with electricity and narrowly surrounded by a wrapper of paraffin, loses, by a first action of the X-rays, a small part of its discharge, and in the following times, after having been freshly charged to its primitive force, it always loses less, so that at the third, fourth, or fifth experiment the discharge is imperceptible or next to nothing. Therefore paraffin, under the action of the X-rays, does not gain in conductivity.

India-rubber behaves almost in the same manner as paraffin.

If the conductor is surrounded first by air and further out by a tube of paraffin, the conductor excited by the X-rays discharges itself, at first rapidly enough; but, soon after, the discharge proceeds, to the last, very slowly. As usual, electricity, carried by air, soon loads the sides of the tube, and then disperses itself with difficulty.

Electricity, scattered from the body, submitted to the action of the rays, can join itself again on a tube of paraffin, or of insulated metals, surrounding the discharging body. This electricity, gathered up on a tube, can be directly observed with an electroscope provided with dry piles, and is found, as is to be expected, of the same nature as that of the body itself.

Insulating liquids (turpentine oil, vaseline, Venetian turpentine, and petroleum) were also examined by me, and they behaved almost in the same manner as paraffin. An electrified conductor submerged in one of these liquids (vaseline oil is the best of all), under the action of the X-rays, discharges itself at first rapidly, but soon after the discharge stops almost entirely.

Lastly, the conductive property of the gases, crossed by the X-rays, increases with their density, and may be ranged in the following order:—

Hydrogen, lighting gas, air, carbonic anhydride, and vapours of ether or carbonic sulphur.

The results, relative to the first four gases, agree with those already given by Righi.

THE CHEMISTRY OF THE HOTTEST STARS.

AT a discussion meeting of the Royal Society, held some two months ago, a paper was read by Mr. J. Norman Lockyer, C.B., F.R.S., under the above title. This has recently been published, and we reproduce the general conclusions.

(1) In a mixture of vapours at a particular temperature, a vapour which is not present in sufficient quantity to show all the lines of its spectrum will be represented by the lines which are longest in its spectrum at the particular temperature in question.

Only some of the short lines in metallic spectra represent the effects of high temperature.

(2) Some of the substances which have been investigated, including iron, calcium, and magnesium, have probably a definite spectrum, consisting of a few lines, which can only be completely produced at a temperature higher than any which is at present available in laboratory experiments. The lines constituting the new spectra are those which either only appear in the spark spectrum, or are lengthened in passing from the arc to the spark. Such lines are termed enhanced lines.

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[1] Experiments published May, June, July 1896, proving that solid and liquid insulators retain their insulating powers under the influence of the Röntgen rays. By Prof. Villari. Communicated by Lord Kelvin.

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(3) In the case of iron, calcium, and magnesium, there are four distinct temperature steps which are marked by spectral changes: (*a*) the flame spectrum, (*b*) the arc spectrum, (*c*) the spark spectrum, (*d*) a spectrum consisting solely of those lines which are enhanced in passing from the arc to the spark.

(4) The order of temperature of certain stars, as determined from a comparison of the extensions of the continuous spectrum into the violet or ultra-violet, is precisely the same as that which follows from a comparison of the metallic spectra at the four stages of temperature.

(5) The variations of the metallic lines furnish the most convenient means of determining relative stellar temperatures, for the reason that photographs with special exposures are unnecessary.

(6) Having ascertained the relative temperature of a star in this way, and assuming that all the absorbing vapours are at the same temperature, the presence or absence of any other metallic substance can be determined by looking for the lines which are longest in its spectrum at that temperature. In the case of the hottest stars, the fourth stage spectrum must be the term of comparison.

(7) Accepting the new results with regard to the lines enhanced in the spark, several lines in the spectra of the hottest stars, for which no origins could previously be assigned, can now be ascribed to metallic substances at the fourth stage of temperature.

(8) The lines of the cleveite gases appear only in the hotter stars, as indicated by the extension of the continuous radiation into the ultra-violet. They increase in intensity with increased temperature in certain stars.

(9) The order of stellar temperatures, determined from the *increasing* intensity of the lines of the cleveite gases, is identical with that determined from the *decreasing* intensity of the metallic lines in the case of those stars which show both series of lines.

(10) Different substances are spectroscopically visible through different ranges of stellar temperatures. The hydrogen lines are visible in stars ranging in temperature from that of α Orionis to that of Bellatrix, while those of the cleveite gases do not appear below the temperature of α Cygni. The enhanced lines of calcium appear at temperatures as low as α Orionis, and persist, with reduced intensity, to the temperature of Bellatrix; those of iron do not appear at temperatures lower than that of α Cygni, and disappear altogether at the temperature of Bellatrix; while the enhanced line of magnesium appears at the temperature of α Cygni, and remains feebly visible at the temperature of Bellatrix.

(11) It follows, then, that the enhanced metallic lines may be absent from a stellar spectrum, either because the temperature is too low or too high.

(12) In the case of those stars which previous investigations have shown to be cooling, the metallic line phenomena are inverted. The enhanced lines first become visible, then the arc lines; while the enhanced lines disappear at a certain stage in the process of cooling the arc lines continue to become stronger.

(13) The lines of the cleveite gases show a similar inversion on the downward side of the temperature curve. Strongly represented in the hottest stars, they thin out very rapidly in cooling stars, and disappear before the arc lines have begun to show themselves.

(14) Utilising the iron lines as a method of bringing together stars of approximately equal temperature, it is found that at each stage the stars are divisible into two groups, which, in accordance with my previous work, correspond to increasing and decreasing temperatures respectively.

(15) As determined in this way, stars of increasing temperature differ from those of decreasing temperature at the same stage of heat: (1) in the greater continuous absorption in the violet or ultra-violet, (2) in the generally greater intensity and breadth of the metallic lines, (3) in the smaller thickness of the hydrogen lines, (4) in the greater thickness of the helium lines at those stages in which they are visible.

(16) These differences are all explained on the meteoritic hypothesis.

(17) There are stars, near and at the top of the curve, which cannot be arranged in order of temperature by the criteria referred to in (15), for the reason that the iron lines have disappeared, and the lines of hydrogen and cleveite gases show little variation.

(18) The arrangement of stars about the top of the curve will depend upon the conditioning of certain lines, at present of unknown origin; the necessary criteria, therefore, require further investigation.

(19) The known facts with regard to changes in the line spectrum of an element can be easily explained on the hypothesis of successive dissociations analogous to those observed in the case of undoubted compounds.

(20) Similarly, the differences in the lines representative of a metal such as iron in the spectra of sun-spots, prominences, chromosphere, or different stars, are explained by supposing that there are different molecular groupings at each stage of temperature.

(21) The change from a continuous spectrum to one consisting of flutings, and afterwards to one of lines, is now acknowledged to be due to the existence of different molecular combinations.

(22) The recent investigations of Humphreys and Möhler on the shifts produced in metallic lines, when the vapours are observed at different pressures, confirm my view that the line spectrum of a metal integrates for us the vibrations of several sets of molecules.

(23) It is argued that the existence of "series" of lines in the spectra of some chemical elements is another indication of molecular complexity, each series probably representing the vibrations of similar molecules.

(24) The behaviour of the magnesium lines in stellar spectra is ascribed by Dr. Scheiner to differences of temperature, in accordance with my experimental results of 1879.

(25) The experiments on the spectrum of mercury which have been made by Eder and Valenta have revealed variations which according to them favour the dissociation hypothesis.

(26) On various grounds, the view that the differences in stellar spectra represent fundamental differences of chemical composition is untenable. The fact that many stars which are widely separated in space give identical spectra, indicates that they not only contain the same "elements," but that the "elements" exist in the same proportions in all.

(27) On the non-dissociation hypothesis, the action of heat on the sun's chromosphere could not produce such a spectrum as that which we know to be associated with hotter stars, since the relative proportions of different vapours could not be changed. The only change which can be imagined to take place on this hypothesis is a reduction of intensity of all the lines due to reduced pressure.

(28) On the dissociation hypothesis, increased temperature would bring about fundamental changes in the spectrum due to molecular simplifications, and in this way the effect of an increase of temperature on the sun's chromosphere, as indicated by hotter stars, can be predicted, and receives a simple and sufficient explanation.

(29) The disappearance of the enhanced iron lines in the hottest stars, and the simultaneous intensification of the lines of hydrogen, helium, and gas X, bring us face to face with the fact that iron is a compound, into the ultimate formation of which one or all of these gases enters.

(30) The ultimate molecules of the chemical elements discussed in the present paper may be provisionally arranged in the following order of resistance to the effects of temperature:—

$$\left.\begin{array}{l}\text{Gas X}\\ \text{He}\end{array}\right\}\text{ Doubtful which.}$$

H
Ca
Mg
Fe

(31) Each step in advance which has been made since 1873, has demonstrated more and more that there is really such a "celestial dissociation" going on as that which I then suggested.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The sixth Robert Boyle Lecture of the Junior Scientific Club will be delivered in the Examination Schools, on Tuesday, June 1, at 8.30, by Captain Abney, C.B., F.R.S., who has chosen for his subject "The Scientific Requirements of Colour Photography."

Mr. W. Garstang, Fellow and Lecturer of Lincoln College,

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